4. So soon as practicable, advanced or collegiate work should be required for admission to medical college.

5. In the advanced studies a wide latitude should be permitted to the conscientious student, that he may cultivate his preferred branches.

6. As the humanistics, such as the classics, philosophy, history, the arts of reasoning, and so forth, have great cultural and disciplinary value, students should be encouraged to pursue them as a historic background against which the present appears.

7. The greatest merit of these studies is not to be sought in their technical values, although a knowledge of Latin and Greek is time-saving in the etymological translation of words and phrases, and facilitates the learning of modern languages; but in that they conduce to a better interpretation of literature, both medical and general, in a broader sense, and are of great refining worth.

IV. THE VALUE OF THE HUMANISTIC STUDIES AS A PREPARATION FOR THE STUDY OF ENGINEERING

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The subject of the technical training of engineers is one that has been treated at some length by many writers within the last decade. In the majority of cases, however, little or no attention has been paid to the earlier or preparatory education of those intending to follow this profession.

The engineering profession naturally demands a training along highly specialized lines, and the consideration of this fact has to a certain extent overshadowed that of the purely preparatory, or what may be called the general education, which must form a basis for this specialization.

In the engineering departments—and, it must also be confessed, in the departments of literature, science, and the arts—of our universities the utilitarian spirit has of late assumed a somewhat prominent place; and, in the endeavor to devote his time solely to those subjects which he considers will be useful or money-producing immediately after graduation, the student in all probability will omit those studies which

are of the nature of general culture. The time which the average man can spend at the university being limited to four years, and in the case of most modern engineering courses four years at a considerable pressure, the demands of the purely technical studies, or those bearing immediately upon the same, have rendered the introduction of any culture studies an impossibility. This is due to the fact that, owing to the recent developments within the sphere of science, there is so much more to teach in the old subjects, so much that the students ought to know about the new, that four years is all too short even for the technical work.

With this atmosphere pervading the educational world, it is not very surprising that the student, in deciding upon the selection of certain courses, will ask himself: "Is this particular study going to be *useful to me?*" In his somewhat immature judgment he is apt to lay greatest stress upon those subjects which he imagines may be converted most easily into cash in the immediate future, losing sight of the fact that there may be other things in life besides the mere accumulation of wealth or expertness in his profession.

It may be pertinent at this time to consider the position of the engineer in the economic and social world of today. In the early days of the profession the only representative was the military engineer; but, as time went on, operations other than those of a military or semi-military character demanded men whose training was not necessarily along military lines. Hence arose the term "civil engineer" as applying to those non-military men engaged in engineering in a general sense. The advent of steam and machinery led to a new class, known latterly as "mechanical engineers," this term being used to distinguish the men who specialized in moving machinery rather than in statical structures. In these later days the name of the various classes of engineers is legion, but it is necessary here to emphasize the second main division of the engineering profession, as in the early days it led to the introduction of a class of men entirely different from the civil engineers. Even at the present day many are apt to couple the term "engineer" with machinery, and its accompanying adjuncts of overalls, grease, and grime.

In the early days before the development of engineering as a science, the only method of obtaining knowledge of machinery was by close

and intimate contact with it. Engineering courses at universities were unknown, and those who took up this profession—or, more strictly speaking, trade—were in the majority of cases men of somewhat limited attainments, so far as general education or culture was concerned. As time went on, and engineering problems began to attract the attention of scientific men, the methods of the profession began to change. The old "rule of thumb" gave place to scientific method, and the demand for men with a thorough grounding in science—or, in other words, educated men—increased. The reason was not far to seek. New problems were arising continually and these required something more than mere practical experience in their solution. Twenty years ago the employer looked askance upon the graduate of a university or technical school; today the majority of large concerns will employ no one unless he is a graduate. A remark made recently by the manager of one of these may perhaps be of interest as showing his complete change of front; he said, in speaking of the work that a university should endeavor to accomplish: "*You* give them the grounding and theory; *we* can give them practice." So far, then, as the profession in itself is concerned, there is at the present day a demand for educated men.

The modern engineer occupies, in many respects, a unique position. In practically all enterprises affecting the public at large either the responsibility is thrown directly upon the engineer, or at least his aid is required partially; in fact, he is reponsible for nearly all those operations which involve the outlay of large sums of money. As compared with his professional brethren in law, medicine, or divinity, he may be said to be in a position of trust to the community at large rather than to the individual.

He is, therefore, brought into contact with all sorts and conditions of society, and must meet men of all professions or trades, not necessarily in a business way only, but also privately or socially. If statistics could be obtained from prominent engineers of today, I have no doubt it would be discovered that the impulse which gave them their early start was due as much to the help of some influential friend as to their own native ability. The faculty of being able to "get on" with everybody (to use an everyday expression) means more to the engineer than many realize.

These considerations, apart from proficiency in his profession, which, as was seen above, demands an educated man, tend to emphasize the fact that he should also be a cultured man; that is to say, a man with some interests outside his own profession, or at any rate one with sufficient training in what may be called the culture studies to appreciate what is being done in professions other than his own.

The above discussion of the position of the engineer in the world of today, although necessarily fragmentary, will perhaps be of assistance in appreciating the arguments which will follow.

There are certain preparatory subjects which may be regarded as common to all professions, but their relative importance may be greater in some than in others. The study of a so-called culture subject may be useful in fulfilling two objects: first, for the knowledge of the subject *per se*, or as an introduction or basis to others; and, secondly, as a general training for the mind.

So far as the profession of engineering is concerned, at least under the existing conditions, the second may be said to have the greater weight; although the importance of the first cannot be overlooked.

While not an exact science, the study of engineering demands definiteness and conciseness of thought, and one of the chief difficulties that those connected with the education of engineers have to overcome is a tendency to generalization on the part of the student.

An analytic, in preference to a philosophic mind is the type that should be cultivated. In order to be successful, the student should have formed the habit of co-ordination and exactness in his earlier years of study.

While it may be the opinion of many that the introduction of some elementary form of science may accomplish this result, I venture to suggest that, as a general rule, studies of this nature will have an effect diametrically opposite, and lead toward vagueness rather than concreteness. What, for example, can be done in a subject such as physiology, when it is taught, not for the science itself, but under the influence, and as a means of propagation, of certain ideas of a serious but somewhat misguided body of women? The time so spent would be far more beneficial, both for a general training of the mind as well as for forming a basis to further studies, if devoted to the humanities.

As a means of inculcating ideas of exactness the study of the humanities is *facile princeps*. The niceties of translation, the importance of gender, number, and case, the proper use of the moods and tenses, and the demands of the relative clause, compel the mind toward a certain definiteness which is lacking in many of the subjects taught in the early stages of education. The most simple translation, or even the study of the grammar of these subjects, demands a directness of attention and a consideration of detail which cannot be otherwise than beneficial to a student whose work in the future will lead him into subjects where generalization is impossible.

As a direct preparation for many studies now required in the engineering curriculum, the humanities also play an important part. In the majority of engineering schools of the present day the first two years are devoted mainly to non-technical subjects, such as preliminary mathematics, English, and modern languages. The benefit of the study of the humanities as a preparation for modern languages is too well known to need discussion at this time. A word, however, may be said regarding the study of English. Few perhaps realize the amount of writing that an engineer has to do, especially if his work is of a consulting character. He is required to report upon numerous schemes; he is often asked to give his opinions relative to the probable success or failure of certain undertakings; and in many cases his evidence in law courts is the ruling factor of the decision. These, together with the preparation of specifications and contracts, demand a familiarity with the English language which, it must be confessed, is often lacking.

While the cultivation of an elegant and literary style is neither demanded nor desired, it is, however, necessary that the engineer should be able to express his ideas concisely, and with at least a certain amount of regard to the common usages of decent English.

It is an everyday experience that the origin of most lawsuits in engineering, especially in cases of interpretation of a specification or in patent suits, may be traceable directly to some idea loosely or inadequately expressed. The English speech, which one of our modern writers has aptly characterized as "the sea that receives tributaries from every region under heaven," requires a background of training in the humanities, at least for a full appreciation of sentence structure, if not for the benefit derived from the study of the grammar of these subjects.

It may be pertinent here to call attention to the amount of time spent upon, and the methods of teaching, English grammar in most of our public schools. The idiosyncrasies of the preposition and the conjunction, the use of the comma and semicolon, and many other details throughout the whole domain of English, are learned by rote; and the ease with which some children can reel off pages of rules, without the slightest idea of their meaning or application, is at once a source of wonder and pity.

I venture to suggest that, if half the time at present devoted to this kind of study of English were spent upon Latin, the net result both from an educational and mind-training point of view could not be otherwise than beneficial.

As a matter of fact, most children begin the study of languages far too late in their curriculum, and there is no reason why Latin, and perhaps French, should not be begun in the grade schools. So much of the earlier part of a language must necessarily be learned by rote that it seems hard to realize why these studies have not been introduced in preference to some of the somewhat useless and inadequate frills so often found in many of our schools. Both in England and Germany, Latin and French are begun at a much earlier time than here—generally between the ages of eight and ten; and, what may seem peculiar, no other studies are neglected to make way for these.

Although the above discussion may be considered as somewhat beyond the scope of the present paper, yet, when the previous arguments are taken into account, I trust I may be permitted this digression.

In connection with the study of the humanities as a preparation for an engineering education, the question as to the length of time that should be devoted to these will naturally arise. The work at present required of engineering students, in the general four-year course, leaves practically no time for elective studies; and even if time were available, it is an open question whether this should be devoted to the further study of humanities or not, especially as in any case it would not amount to a sufficient number of college hours to prove beneficial. In the years immediately preceding the university—that is to say, throughout the high-school course—the study of the classics is certainly most desirable. At present the engineering department of this

university accepts only two years of Latin for entrance requirements; but in all probability these conditions will be revised in the future.[1]

If the languages could be begun in the grade schools, then perhaps three years of classics in the high schools would prove sufficient for most cases. The last year could then be devoted to those subjects—such as chemistry, physics, and modern languages—which would cover the other entrance requirements. After all, the object of a university entrance examination is simply to show that the student has a moderately well-trained mind; and I venture to suggest that one who has devoted his time to the study of the humanities will be in as good a condition to absorb the university work as one who has spent his time in getting a smattering of a number of subjects, some of which are practically useless.

It may be interesting to notice that, on the average over the past three years, 49 per cent. of the total number of entrance languages presented by candidates for admission to our engineering department were Latin, about 37 per cent. German, and 11 per cent. French, and the remainder a small fraction of Greek, Spanish, or no languages at all. Of these it is a little difficult to say, without looking up a mass of certificates, how many students had more than two years of Latin; but the presumption is that the majority did not have more than this amount. While two years of a language such as Latin is certainly better than none at all, it is doubtful if a student has any particular grasp of the subject in so short a time.

The difficulties attendant upon the somewhat crowded conditions of work in the regular four-year course, as well as the demand for men with a somewhat broader education, have led the engineering faculty of this institution to consider the advisability of arranging a six-year combined literary and engineering course.

As, however, the technical work has been revised and rearranged during the past year—and this in itself has entailed a considerable amount of change—the committeee in charge of the proposed course deemed it wise to see how this new scheme worked before reporting upon any further possibilities of extension. In a general way it may be said that the work in the literary department will be chosen so as to

[1] Since the reading of this paper, the Engineering Department of the University of Michigan has decided to accept two, three, or four years of Latin. Greek is also accepted for entrance.

give the student a good general course—with perhaps a few electives, but not many. It is the desire of the department to give the student a broader education, especially on the culture side.

With this in view, it is hardly necessary to point out the advisability of the study of the classics in the high-school grades. Even with a six-year course, provided that a student had at least four years of Latin previously to his coming to the university, it is doubtful if there would be any particular advantage in the continuance of this line of study in his higher education.

While the writer is aware that many points in connection with the subject of this paper have remained unconsidered, or dwelt upon somewhat lightly, it was thought best to give a general survey of the conditions at present obtaining in the engineering profession, and to trust that some of the important details would come up in the discussion.

In conclusion, it may be said that it should be the desire and aim of everyone connected with the education of engineers to raise the standard of the average or rank and file of the profession, so that in the future it will not be a source of wonder and surprise when an engineer is discovered who has interests outside his profession, and who can appreciate art and literature for themselves alone.

V. DISCUSSION OF PROFESSOR SADLER'S PAPER

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Mr. Chairman, Ladies and Gentlemen:

Engineering as a profession has come to a sudden popularity. At the present moment, taking it in all its branches, it may safely be called the most popular of the professions; and it also, from its traditions, is looked upon as a most practical profession. It was developed essentially as such, and those who simply look at it from the outside so regard it. That was its original characteristic, and it may be interesting to note that some of its early exponents felt that when they had completed their life, they had done all the engineering it was necessary for anyone to do.

It is related of Thomas Telford, one of those early civil engineers to whom Great Britain owes so many of her canals and roadways, that when a young man made application for the privilege of studying engineering under him, he replied